

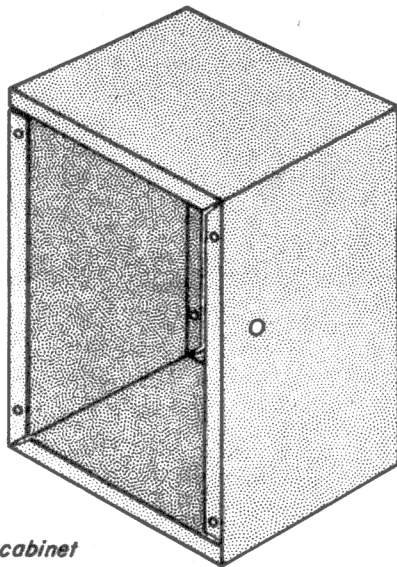
ELECTRONIC FUNDAMENTALS

EXPERIMENT LESSON 21

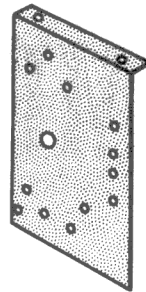
SIGNAL GENERATOR ASSEMBLY II



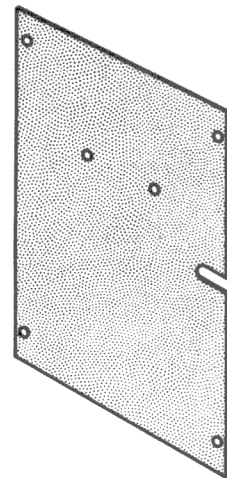
RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION OF AMERICA
HOME STUDY SCHOOL
350 West 4th Street, New York 14, N. Y.



cabinet



tuning-assembly plate



rear panel

All the parts in Kit 11 are listed below. Check the parts you receive against this list. Make sure you have the correct quantity of every item. If a part is either missing or defective upon arrival, request a replacement from Department R, Home Study School, RCA Institutes, Inc., 350 West 4th Street, New York 14, N.Y. *Your request must include your name and student number, the complete name and description of the part copied from the Item column below, the Quantity missing or defective, and the reason you are asking for a new part.*

KIT 11 BILL OF MATERIALS

Quantity	Item
5	Oscillator coil for signal generator
1	Resistor, 4,700 ohms, 1/2 watt
1	Capacitor, 20 $\mu\mu\text{f}$, mica, 500 volts,
1	Variable capacitor, 365 $\mu\mu\text{f}$
1	Tuning-assembly plate
2	Alligator clip
3'	Coaxial cable RG-59/U
1	Pointer for signal generator
18"	Tinned copper braid
1	Cable connector
1	Rotary switch
1	Cabinet
1	Rear panel for cabinet

If you get a part slightly different from a part described in this list, the substitute part will not interfere electrically or mechanically with your experiments or equipment.

Experiment Lesson 21

OBJECT

1. To complete the construction of the signal generator.
2. To calibrate the signal generator.

EQUIPMENT NEEDED

Front panel and subchassis of signal generator, prepared in Experiment Lesson 20.

Tuning-assembly plate, bracket, signal-generator case, and rear panel.

Set of five coils

One band switch, 2 section, 2 circuit, 6 position.

One resistor, 4,700 ohms 1/2 watt, (R_6)

One capacitor, 20 μmf mica, (C_{10})

One capacitor, variable, 365 μmf , (C_{11})

Four knobs

One plastic pointer

Two alligator clips

Three feet of RG-59/U coaxial cable

One cable connector

One 18-inch length of $\frac{1}{4}$ -inch tinned copper braid

Soldering iron, solder, and various hand tools

Hardware from envelope (Kit 9)

INFORMATION

In this section, you will assemble and wire the tuning-assembly plate on which the bandswitch, coils, and tuning capacitor are mounted. These components determine the r-f oscillator frequency. This frequency depends on the coil, which is connected across the tuning capacitor by the bandswitch, and on the setting of the tuning capacitor. The bandswitch has six positions, of which five are used for Bands A to E. When only audio output is desired, the X position is used to turn off the r-f oscillator. The bandswitch shown in Fig. 21-1 is a two-wafer six-position rotary switch. In order to wire the switch you must learn to identify the various

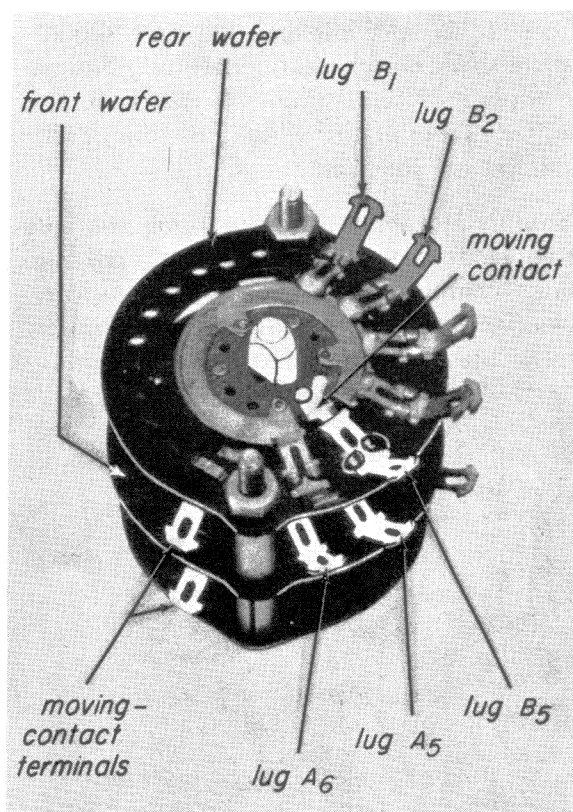


Fig. 21-1

parts of the switch. Study the figure and labeling carefully. Be sure you can identify the parts of the switch before you go on. One wafer is called the front wafer and the other is the rear wafer, as shown. The switch lugs are numbered in a clockwise manner, starting at the right of the hex nut, as shown. Each wafer has six fixed contact terminals or lugs on one side of each wafer and one moving contact lug on the other side of each wafer. The lugs on the front wafer are identified as A_1, A_2 , etc. The lugs on the rear wafer are identified as B_1, B_2 , etc. For example, the third lug on the front wafer is lug A_3 .

Note: Stops are used to limit the rotation of the switch to the six desired positions. The switch that you receive may have factory-preformed stops. In this case, begin with Step 4 of the next job. If your switch has adjustable stops, as shown in Fig. 21-2, begin with Step 1.

JOB 21-1

To set the stops in the bandswitch, mount the bandswitch, and wire the rotor terminals.

Procedure.

Step 1. Remove the nut and lock washer from the bandswitch shaft. Carefully remove the adjustable stop ring and the stop pin from the face plate. Place all four parts aside. Do not lose any parts.

Step 2. Mount a pointer knob on the switch shaft and rotate the switch till the moving contact is connected to lug 5 as shown in Fig. 21-1. Remove the knob.

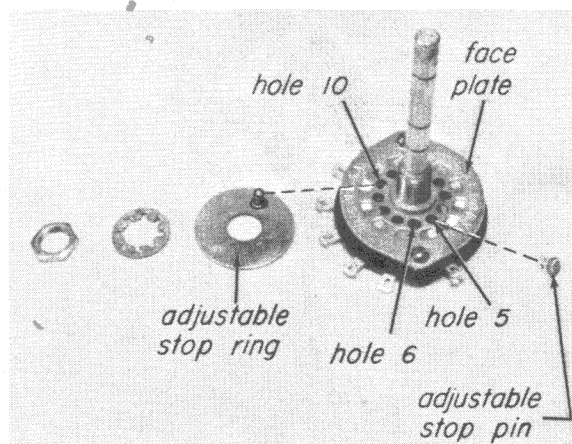


Fig. 21-2

Step 3. Hold the switch with the lugs to the left, as shown in Fig. 20-2. There are 12 holes in the plate. Assume they are numbered like the hours on a clock face. Place the adjustable stop pin in the hole number 5 and the pin of the adjustable stop ring in hole number 10. Replace the lock washer on the switch shaft above the ring stop. Hold the switch with the shaft up, so that the stop pins do not fall out.

Step 4. Hold the tuning assembly plate with the flange down over the switch, and put the switch shaft through the large hole in the plate. Thread the locknut on the shaft, making it only finger tight. Rotate the switch until the moving contact lugs face the flange and are in line with the hole nearest the flange, as shown in Fig. 21-3. Now tighten the mounting nut, keeping the switch in this position.

Step 5. Cut a length of hookup wire 3-1/2 inches long, and remove 1/4 inch of insulation from each end. Cut one lead of the 20- μmf mica capacitor (C_{10}) so that it is 3/4 inch long. Cover this lead with 1/2 inch of spaghetti. Bend a small hook in the bare wire extending beyond the spaghetti, and a similar hook in the end of the 3-1/2 inch piece of hookup wire. Connect the capacitor

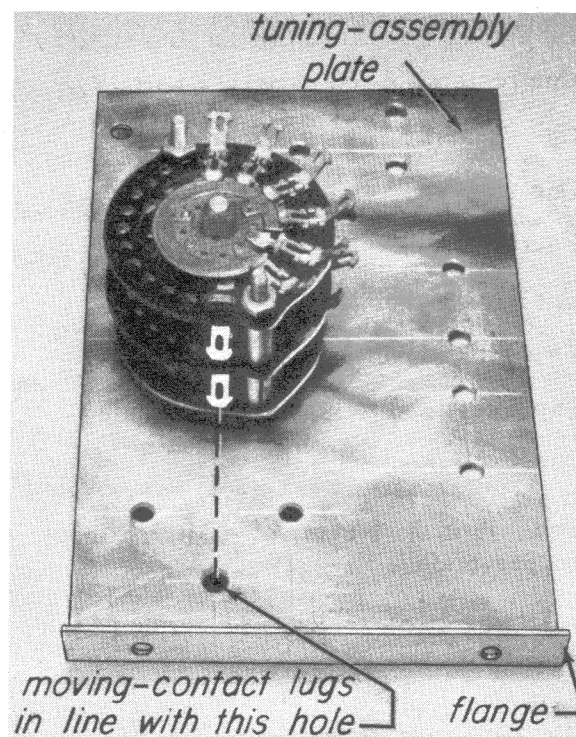


Fig. 21-3

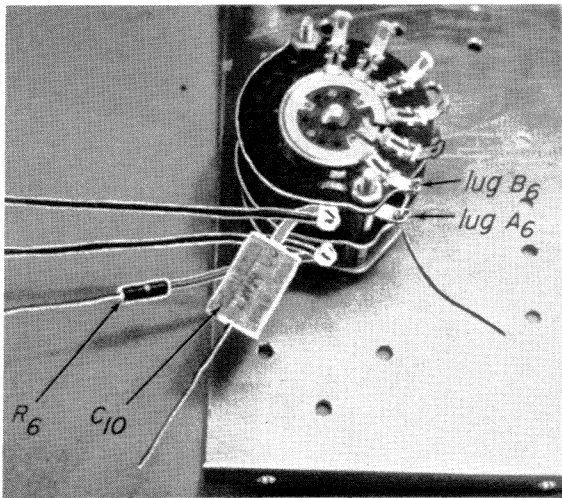


Fig. 21-4

and wire to the moving contact terminal of the rear wafer and solder, as shown in Fig. 21-4.

Step 6. Cut a 2-1/2 inch piece of hookup wire and remove 1/4 inch of insulation from each end. Cover one lead of the 4,700-ohm resistor (R_6) with spaghetti, leaving about 1/4 inch of bare wire projecting. Bend a small hook in the resistor lead and also in the end of the 2-1/2 inch piece of hookup wire. Connect the resistor lead and the hookup wire to the moving contact terminal of the front wafer and solder, as in the figure.

Step 7. Cut another 2-1/2 inch length of hookup wire and pull the insulation completely off the wire. Use this bare wire to connect switch terminals B_6 and A_6 together, with the loose end of the wire projecting from terminal A_6 . Solder the connection at A_6 and B_6 . After you have completed this wiring, the switch should appear as shown in Fig. 21-4. Put the tuning assembly plate aside and go on to the next job.

JOB 21-2

To check and prewire the oscillator coils before they are mounted.

Information. The signal generator uses a set of five coils, one for each frequency band on which the signal generator operates. These coils are shown in Fig. 21-5 as they appear after you have completed this job, in which you solder the connecting wires to the coil terminals. The wires should be connected exactly as shown in the figure. For example, two of the wires connected to the band A coil extend to the left of the coil, one to the right.

Each coil has three terminals, numbered 1, 2 and 3. The terminals can be located by their positions on the coils. Terminal 1 is always at the top of the coil form and terminals 2 and 3 are at the bottom (near the spade lugs). Terminal 3 is always grounded and is connected to one of the spade lugs by grounding wire. Lay your coils out on the bench to correspond with Fig. 21-5. Compare your coils with the figure and study them carefully until you can identify the coils and you are sure you know which are terminals 1, 2, and 3 on each coil. Note that terminal 2 is not used on the band E coil. A lead is already soldered to the center-tap of the coil, which serves as terminal 2 of this coil.

When making a connection to a coil terminal, twist a small hook in the end of the wire and put the hook through the terminal. Tighten the connection with long nose pliers before soldering. Be careful not to twist or pull on the coil terminals or they may break off the coil form. When you solder to a terminal, heat the terminal until the

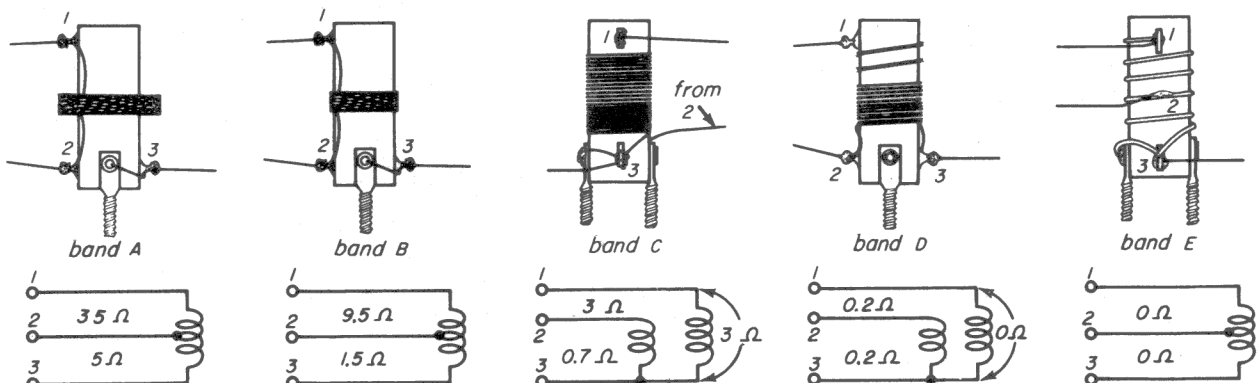


Fig. 21-5

solder flows freely around the joint. When soldering on or near the coils, be careful not to burn the coil windings or coil form with your soldering iron.

Procedure.

Step 1. Cut five lengths of hookup wire, each 1-3/4 inches long. Pull all the insulation off the wires. Bend a small hook in one end of each wire. Connect one wire to each terminal 1 (top terminal of each coil). Solder the wires in place, heating the terminals until the solder flows. Do not burn the coils. Do not disturb the joints until the solder cools. Test each connection to make sure it is not a cold solder joint.

Step 2. Cut three lengths of hookup wire each 1-1/2 inches long, and one length 1-3/4 inches long. Strip all the insulation from these wires. Connect the 1-1/2-inch wires to terminal 2 of the band A, B and D coils as you did in Step 1. Connect the 1-3/4-inch wire to terminal 2 of the band C coil and solder all the wires in place.

Step 3. Cut and strip five 1-inch lengths of hookup wire. Connect and solder one wire to the terminal 3 of each coil. Terminal 3 is the bottom terminal, which is connected to a spade lug. Your coils should look like Fig. 21-5 after this job is completed.

Step 4. Set up your multimeter to measure resistance on the $R \times 1$ range. Carefully zero the ohmmeter. Measure the resistance between the terminals of each coil. Compare your readings with those given in Fig. 21-5. Although your readings need not be exactly the same as those given, they should agree within about $\pm 10\%$.

JOB 21-3

To mount the coils on the tuning-assembly plate and wire them to the bandswitch.

Procedure.

Step 1. Mount coil E with its terminals pointing toward the far side of the plate as shown in Fig. 21-6. Use two #6 lock washers and two 6-32 nuts. Connect the wire from terminal 1 of coil E to bandswitch lug B₁. Connect the wire from the tap on coil E to

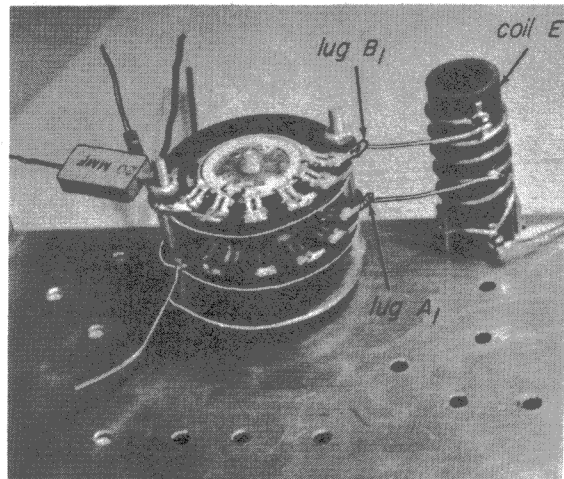


Fig. 21-6

switch lug A₁. Solder both connections. Your plate should now look like Fig. 21-6.

Step 2. Mount coil D as shown in Fig. 21-7, using lock washers and nuts. Connect the wire from coil terminal 2 to switch lug A₂. Connect the wire from coil terminal 1 to switch lug B₂. Solder both connections. Your plate should now look like Fig. 21-7.

Step 3. Mount coil C as shown in Fig. 21-8. Connect the wire from coil terminal 2 to switch lug A₃. Connect the wire from coil terminal 1 to switch lug B₃. Solder both connections.

Step 4. Mount coil B as shown in Fig. 21-8. Connect the wire from coil terminal 2 to switch lug A₄. Connect the wire from coil terminal 1 to switch lug B₄. Solder both connections.

Step 5. Mount coil A as shown in Fig. 21-8. Connect the wire from coil terminal 2 to switch lug A₅. Connect the wire from

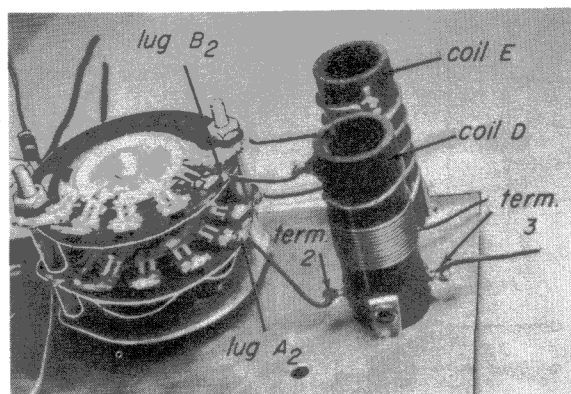


Fig. 21-7

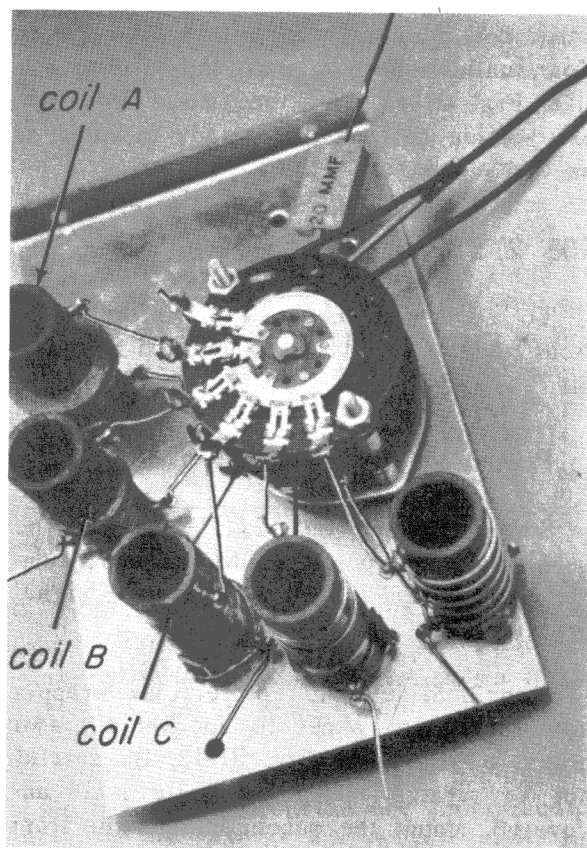


Fig. 21-8

coil terminal 1 to switch lug B_5 . Solder both connections. Your plate should now look like Fig. 21-8.

JOB 21-4

To wire the ground braid from the r-f oscillator and mount the tuning capacitor.

Procedure.

Step 1. Wrap the wire from terminal 3 of coil E around the braid at a point five inches from right end as shown in Fig. 21-9.

Step 2. Dress the braid close to the other coils as shown in the figure. Wrap the wires from terminal 3 of coils D , C , B , and A around the copper braid. The braid should be as close as possible to terminal 3 of each coil. You should have about five inches of braid left extending coil A .

Step 3. Solder the braid to the wires at all five coils. Remember that the heavy braid

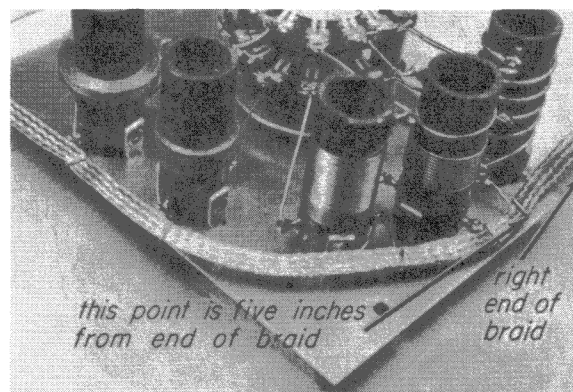


Fig. 21-9

conducts heat away. Heat each joint long enough to make the solder flow readily and use generous amounts of solder at each joint. Be careful not to burn the coil.

Step 4. Mount the tuning capacitor under the bandswitch with its shaft extending in the same direction as the bandswitch. The tuning capacitor is mounted with three 6-32 x 1/4-inch screws, as shown in Fig. 21-10. Do not use longer screws or they will damage the tuning capacitor rotor. Place a flat washer and a grounding lug under the mounting screw closest to coil A and a flat washer and lock washer under each of the other two screws.

Step 5. Bend the ground braid up close to the grounding lug, as shown in the figure. Pass the wire from bandswitch lug A_6 through the ground lug and use it to tie the braid to this ground lug. Solder the connection. Your tuning assembly plate should now look like Fig. 21-10.

Step 6. Connect the wire from the moving contact lug on the bandswitch rear wafer (to which the 20- μ mf mica capacitor is connected), to the tuning capacitor stator lug nearest the plate, as shown in Fig. 21-11. Solder the connection.

Step 7. You have already soldered one lead of the 4,700-ohm resistor R_6 to the moving lug on the front wafer. Cut a piece of spaghetti to cover the other lead, leaving 1/8 inch of bare wire projecting. Connect this lead to the unused terminal lug at the

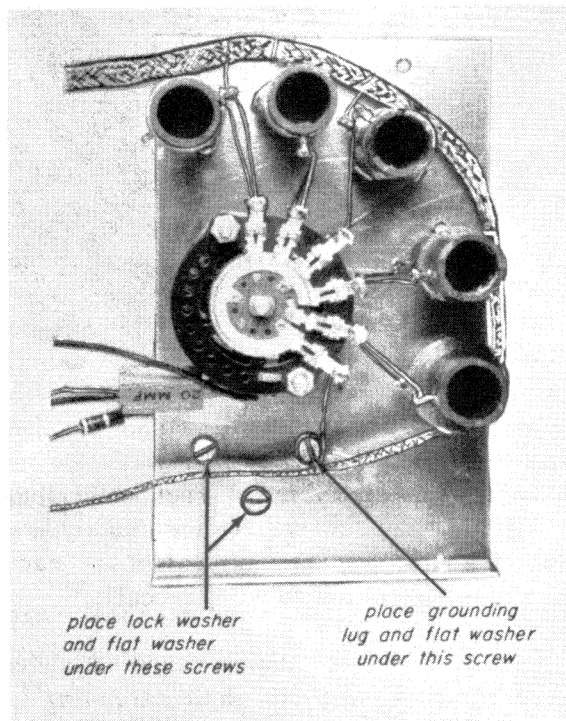


Fig. 21-10

bottom of coil *E*. Cut a two-inch length of hookup wire, strip 1/4 inch of insulation from each end, and connect one end to the

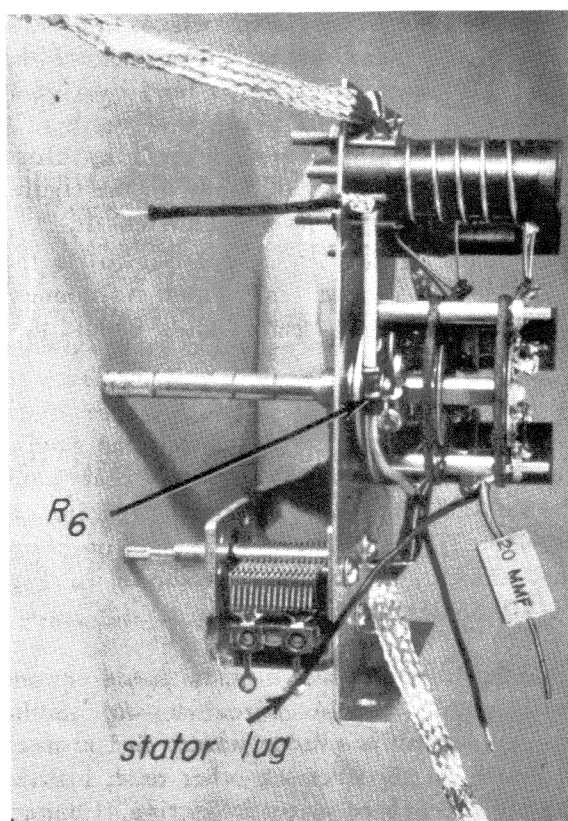


Fig. 21-11

same coil terminal. Solder the connection. Your tuning assembly plate should now look like Fig. 21-11. Put the tuning assembly plate aside until you are ready to mount it on the subchassis.

JOB 21-5

To mount the subchassis, wire it to the front panel and wire the line cord and on-off switch.

Procedure.

Step 1. Remove the 12AU7 tube from the subchassis and put it aside until you complete the assembly and wiring of the signal generator.

Step 2. Slide the protective wrapper down the front panel to uncover the two holes, as shown in Fig. 21-12. Be careful not to scratch the panel while it is uncovered. Mount the subchassis on the front panel with two 6-32 binding head screws and hex nuts, as shown in the figure. Do not

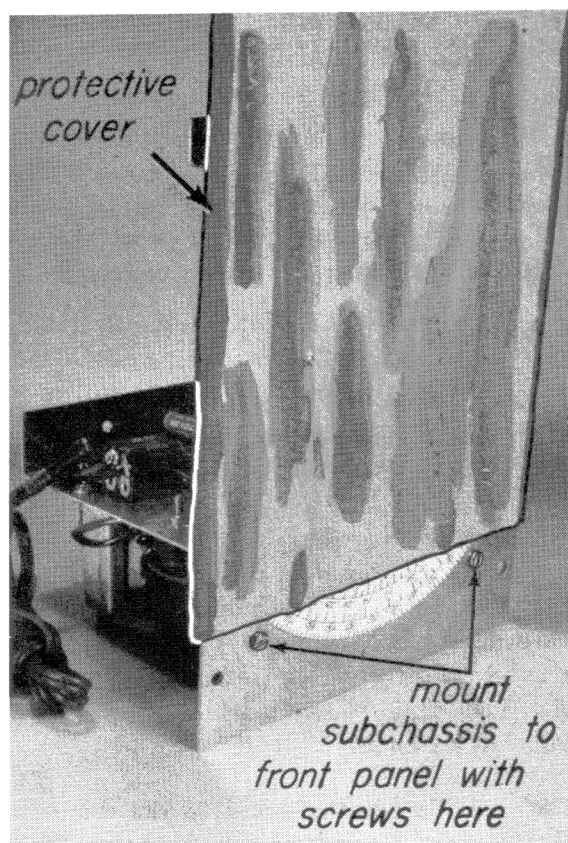


Fig. 21-12

forget to place two #6 lock washers under the nuts. Replace the protective wrapper on the front panel and keep it on.

Step 3. Remove the tape from the two 11-1/2 inch leads that connect to TS-B and TS-C. Unsolder the connection and separate the leads. Identify the lead from TS-C by bending a hook in the bare end of the wire. Run both leads to the switch section of the AF OUT/INT MOD control, as shown in Fig. 21-13. Dress the wires as shown in the figure. Connect the lead from TS-C to the same switch terminal to which the 0.01- μ f capacitor (C_4) is connected. Connect the other 11-1/2 inch lead to the other switch terminal. Solder both connections.

Step 4. Connect the lead from tube-socket terminals 4 and 5 to the pilot-light terminal. Dress the wires as shown in the figure. Solder the connection.

Step 5. Cut the line cord at a point one foot from TS-A. Run the one foot piece of wire to the rear of the chassis along the

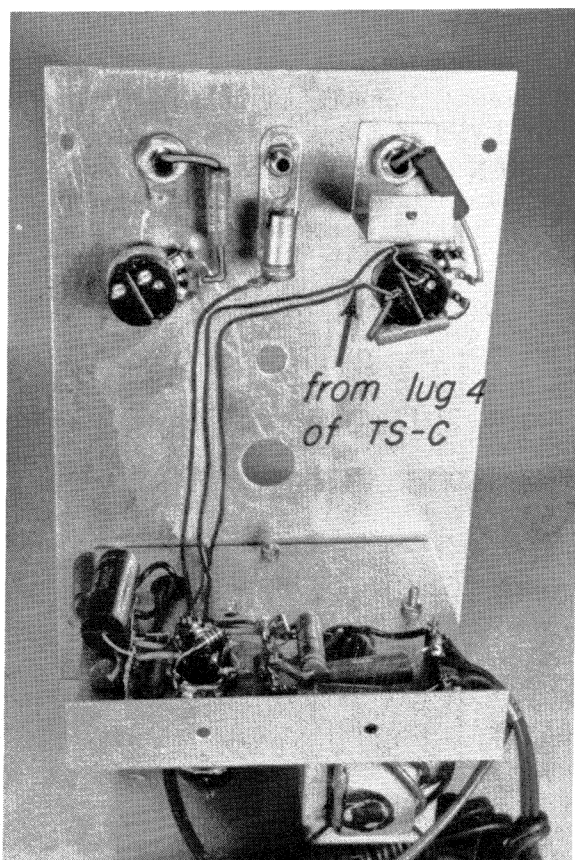


Fig. 21-13

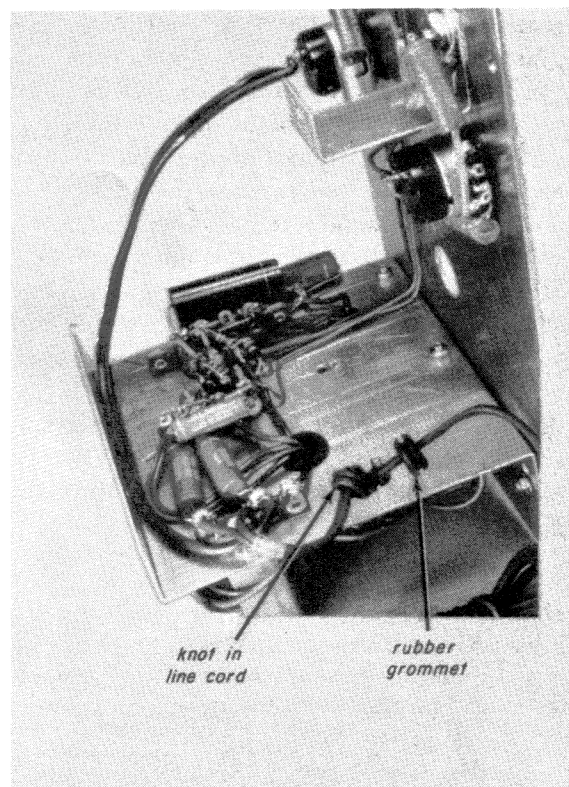


Fig. 21-14

inside corner to a point behind TS-C, as shown in Fig. 21-14. Then run the wire directly to the switch terminals on the R-F ATTEN control, as shown. Connect the wires to the terminals and solder the connection.

Step 6. Strip 1/2 inch of the insulation from the line cord wire you cut off in the last step. Place a 3/8-inch grommet on the line cord and tie a knot in the wire three inches from the end of the wire. Your line cord should look like Fig. 21-14.

Step 7. Remove the wire jumper soldered between terminals 1 and 2 of TS-A. Connect the remaining line cord wire to terminals 1 and 2 and solder the connection.

Step 8. Remove the protective wrapper from the panel and discard it.

JOB 21-6.

To mount the tuning assembly plate and complete the wiring of the signal generator.

Procedure.

Step 1. Remove the nut and lock washer from the screw that holds the selenium

rectifier in place. Move the tuning assembly plate into its position on the subchassis and guide the capacitor shaft and switch shaft through their holes in the front panel. Pass one hole in the flange of the plate over the rectifier screw, and replace the lock washer and nut. Use a 6-32 x 1/4-inch screw, lock washer and nut to fasten the other side of the plate as in Fig. 21-15. Also fasten the L-shaped bracket to the tuning assembly plate with a 6-32 x 1/4 inch screw, lock washer and nut as shown in the figure. Tighten these screws after you have centered the switch shaft and tuning capacitor shaft in the front panel holes. Your assembly should now look like Fig. 21-15.

Check to see that there is sufficient clearance between the subchassis and the lugs on the trimmer capacitor. If necessary, remove the tuning assembly plate, and bend the lugs carefully to obtain more clearance.

Step 2. Cut two one-inch pieces of hookup wire and strip all the insulation off the wires. Bend the wires into an open V shape. Put one wire through terminal 1 of

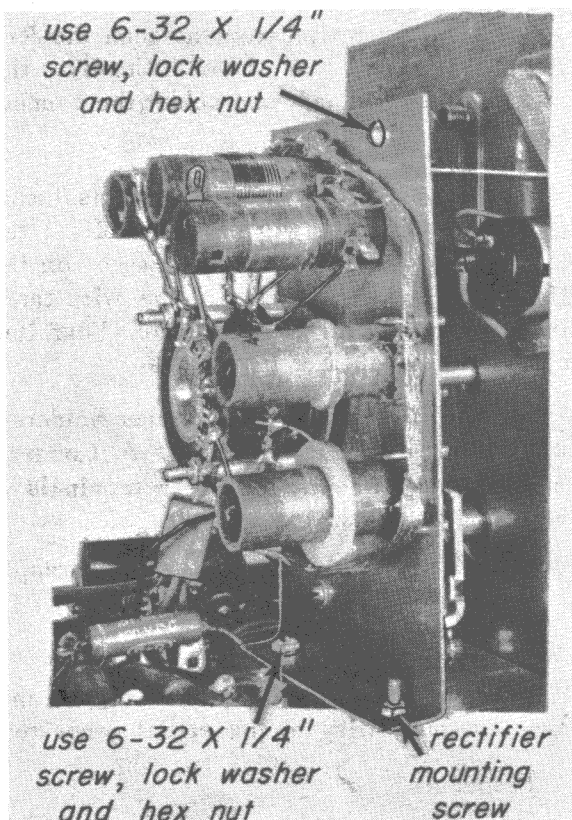


Fig. 21-15

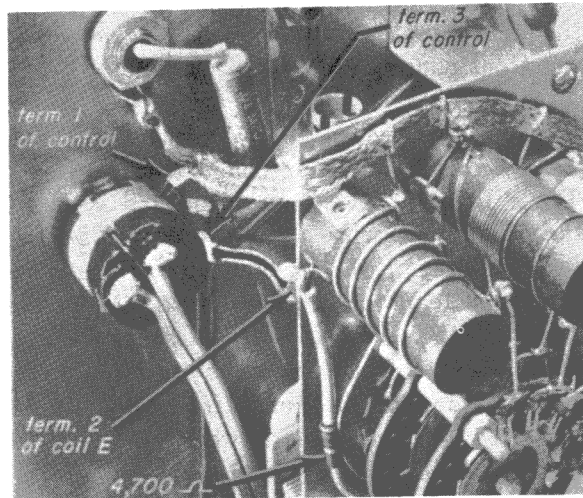


Fig. 21-16

the R F ATTEN control. This terminal is the one closest to the R-F OUTPUT chassis connector. Use the wire to tie the braid from the tuning assembly plate to terminal 1. Insert the other piece of bare wire through the grounding lug on the R-F OUTPUT chassis connector, and tie the end of the braid to this lug. Solder the braid to the terminal and ground lug. Cut off any excess. Figure 21-16 shows how your braid connection should look.

Step 3. Connect and solder the wire from terminal 2 of coil E to terminal 3 of the RF ATTEN control, as shown in Fig. 21-16.

Step 4. Cover the lead from the 20- μ f capacitor (C_{10}) with a 1/2-inch piece of spaghetti and cut the lead, leaving about 1/4-inch of wire projecting. Connect this wire to pin 7 of the 12AU7 socket, as shown in Fig. 21-17. Connect the hookup wire from

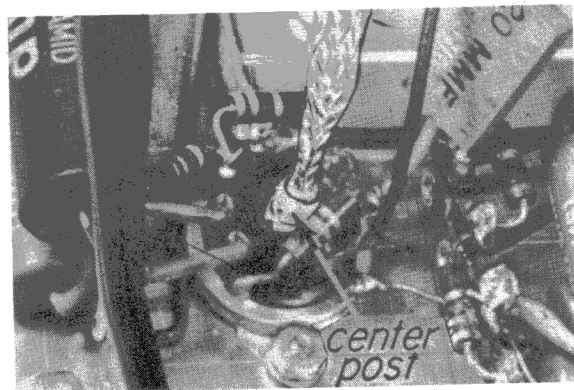


Fig. 21-17

the moving contact lug of the front wafer to pin 8 of the tube socket. Solder both connections.

Step 5. Roll the other end of the ground braid together in your fingers until it is round and small enough to fit inside the tube-socket ground post. Push the end of the braid into the tube-socket center post and solder it in place. Your tube socket should then look like Fig. 21-17.

JOB 21-7

To install the tube and mount the knobs.

Procedure.

Step 1. Place the 12AU7 tube in its socket.

Step 2. Rotate the bandswitch to its maximum counterclockwise position (band A). Rotate both controls to the off position. Rotate the tuning capacitor shaft until the plates are fully meshed.

Step 3. Mount the two control knobs with the indicators at the off positions. Tighten the set screws. Mount the bandswitch knob and tighten the set screw with the pointer in the Band A position. Put the plastic pointer on the tuning capacitor shaft, and tighten the set screw with the pointer lined up with the horizontal line on the left side of the scale. Tighten the set screw securely; be careful not to split the screw-head apart. Mount and tighten the tuning knob on the tuning capacitor shaft. Your front panel should appear as in Fig. 21-18.

JOB 21-8

To wire an output cable for the signal generator.

Procedure.

Step 1. Solder a pair of alligator clips on the RG-59/U cable, using the same method given in Experiment Lesson 2, Job 2-7.

Step 2. Cut off one inch of the rubber covering on the other end of the shielded cable.

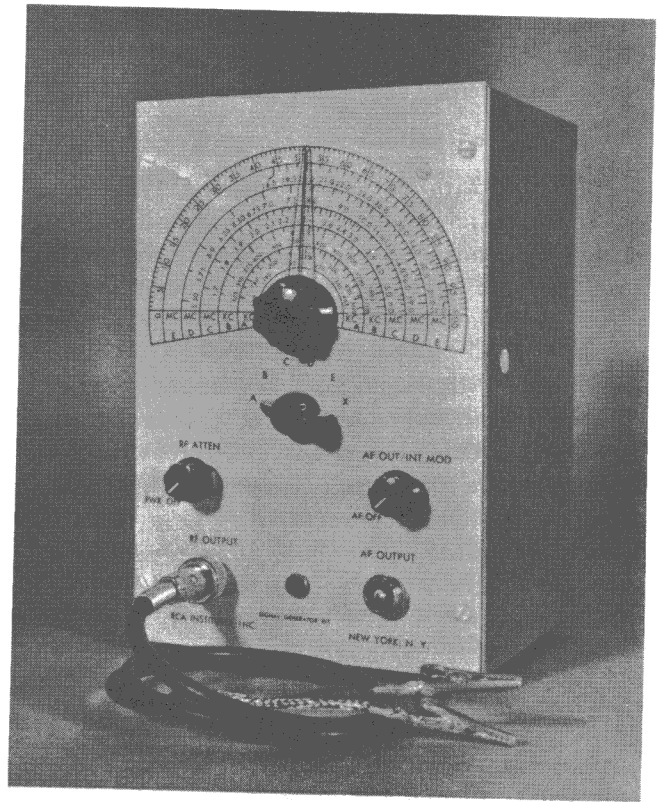


Fig. 21-18

Step 3. Loosen the small screw on the cable connector and pull out the spring. Be careful not to lose this small screw. Holding the cable in one hand, put the large end of the spring over the braid, rotating the spring away from you while you push it over the braid. When the spring is on all the way, about 1/2 inch of braid should extend beyond it. With a nail or test prod, comb out the strands of the braid, separating each strand from the others, and bend them back on the spring smoothly. Cut off all the strands so that they extend back only about 1/8 of an inch on the spring, as shown in Fig. 21-19. Solder the braid to the spring at one point, using as little heat and solder as possible.

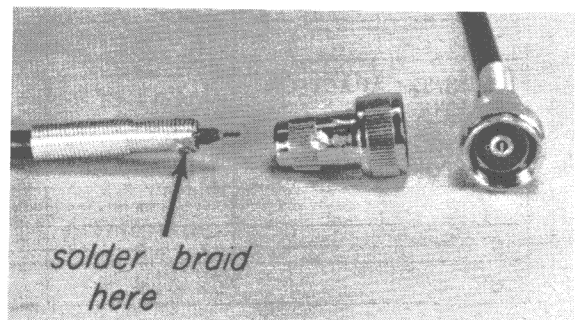


Fig. 21-19

You may have to file off any excess solder to make the spring fit into the cable connector. Too much heat may burn the plastic insulation.

Step 4. With a knife, remove 1/4 inch of the plastic insulation. Use the knife as if you were sharpening a pencil. Be careful not to nick the wire, or it may break off inside the connector later.

Step 5. After making sure that the small screw in the cable connector is backed out enough so that it will not interfere with the spring, push the spring back into the cable connector. If the center wire is bent, it may not come through the hole in the center of the cable connector, so make sure that the wire is straight.

Step 6. After the wire comes through the center hole, cut it off level with the top of the metal rivet, and solder it in place. Do not use too much solder or it may run inside the connector and cause a short. Now tighten the small screw to hold the spring in place.

Step 7. Now you are ready to test the cable with your ohmmeter. Using the lowest resistance range ($R \times 1$), check the resistance

between the body of the chassis connector and the alligator clip connected to the braid. It should be extremely low or zero. Now check between the other alligator clip and the center connection on the cable connector. The resistance should also be zero. Then set up your ohmmeter to the highest resistance range ($R \times 10K$), and check the resistance between the two alligator clips. The resistance should be extremely high or infinite. Your meter needle should not move at all. You are now sure that your cable and clips will not short the output of the signal generator, and that the output voltage will not be reduced by unnecessary resistance in series with the output. If you fail to get output from the signal generator at any time when you are sure that the signal generator is in good condition and operating, test the output cable in this way. Output cables may open or short inside the cable after hard use. If the cable becomes shorted or open after it has been used, cut the cable about a half inch back from the spring insert, or a half inch back from the point where the wire divides to the alligator clips, and follow the same procedure to attach the alligator clips or cable connector again. The break will usually be found near either end where the cable is bent or twisted most when it is used.

TABLE A

Pin Number	Modulation Switch	Band Switch	Given Resistance	Measured Resistance
1	OFF	*	∞ (infinite)	∞
1	ON	*	250 k-to 10 megohms **	260K
2	*	*	47,000 ohms	46,000
3	*	*	330 ohms	350
4-5	*	*	0.5 - 1 ohm	0.6
6	*	*	250 k-to 10 megohms **	280K
7	*	X	33 k-ohms	34K
7	*	A	33 k-ohms	32K
TUNING CAPACITOR STATOR LUG	*	A	44 ohms	38
TUNING CAPACITOR STATOR LUG	*	X	∞ (infinite)	∞
8	*	X	10,000 ohms	10K
8	*	A	5 ohms	4.8
9	*	*	0 ohms	0

* Switch position does not affect reading

** Readings depend on condition of electrolytic filter capacitors. Note: connect positive lead of meter to plate; negative to chassis.

JOB 21-9.

To make resistance and voltage checks of the signal generator.

Procedure.

Step 1. Place the signal generator in front of you, upside down, so that it rests on the front panel and the power transformer. With your multimeter in the R x 1 position, measure the resistance across the line plug. The resistance should be infinite with the a-c line switch off and about 80 to 90 ohms with the switch on. This is the d-c resistance of the primary winding of the power transformer.

Step 2. Measure the resistance between each pin of the 12AU7 socket and the chassis and fill out Table A. Do not plug in the signal generator.

If any of the resistance values that you measured differed more than 20% from the given values, recheck your wiring before you

go to the next step. Make sure to use the R x 1 range when checking low resistances.

Step 3. Connect the signal generator to a 115-volt, 60-cycle a-c outlet, and turn the power switch on. The pilot lamp and 12AU7 filament should light. If they do, continue with Step 4.

If both the pilot lamp and the tube do not light, switch the signal generator off immediately. Check for line voltage across lug 1 and lug 2 of TS-A. If line voltage is present, disconnect the signal generator from the power line and check the wiring. If line voltage is not present, check the power cord and try a different a-c outlet. When you have the circuit operating properly, continue with Step 4. If you cannot see the trouble by inspection of the wiring, make further checks as described in Service Practices 9 and 14.

Step 4. Measure the voltage between each pin of the 12AU7 socket and the chassis, and record the voltages in Table B. Before making a reading, look at the given voltage

TABLE B

Pin Number	Modulation Switch	Band Switch	Given Voltage	Measured Voltage
1	OFF	A	-0.5 volts d.c.	-0.6
1	ON	A	65 volts d.c.	58
1	ON	X	95 volts d.c.	88
2	ON	X	-0.7 volts ² d.c.	-0.7
2	ON	A	0 volts d.c.	0
3	ON	A	1.30 volts d.c.	1.3
4-5	—	—	6.3 volts a.c.	6.5 ac
6	OFF	A	92 volts d.c.	82
6	ON	X	95 volts d.c.	89
6	ON	A	65 volts d.c.	59
7	OFF	A	-2 to -11 volts ¹ d.c.	-3.2
7	ON	A	-1.0 to -10 volts d.c. ¹	-2.2
8	ON	A	Less than 0.1 volt d.c.	0.09
8	ON	X	6 volts d.c.	5.5

¹ Varies with setting of tuning capacitor.

² Measure on 25 VDC range.

column and set your meter to the proper range. The meter should be set for d-c voltage readings at all pins except pins 4 and 5. These records will be very helpful should you ever need to troubleshoot your signal generator.

JOB 21-10.

To test the operation of the output controls.

Procedure.

Step 1. Turn the signal generator on and set the bandswitch to Band X.

Step 2. Connect the output cable to the AF OUTPUT connector on the front panel.

Step 3. Set your meter to read a-c volts on the 75-volt a-c range, and clip the output cable to the meter test leads.

Step 4. Vary the AF OUT/INT MOD control and observe the meter. If the audio-output circuit is properly wired, you should be able to vary the amount of audio output with the control. Your meter should read from zero to about 10 volts as you vary the control from minimum to maximum. If there is no audio output, you can trace the audio with the meter from the audio-oscillator plate (pin 1 of the 12AU7) to the output connector and find where it gets lost. When measuring audio at the 12AU7 plate, however, connect the positive meter test lead to the OUTPUT jack of the meter.

Step 5. Set the bandswitch to Band A; tune the signal generator to the highest frequency of this band.

Step 6. Turn the AF OUT/INT MOD control off.

Step 7. Connect the output cable to the RF OUTPUT connector.

Step 8. Switch to 15 VAC range. Vary the RF ATTEN control. You should read about one volt when the control is at maximum.

The r-f output circuit can also be traced with your meter from the cathode (pin 8) of the oscillator to the RF OUTPUT connector.

Step 9. Repeat Step 8 for Band B.

JOB 21-11

To calibrate the signal generator.

Information. After the signal generator is completed and operating properly, the actual frequency of the r-f output signal may not agree with the scale markings on the front panel. This is caused by the variation in stray capacitances between the wiring and the chassis, and by the normal variation in component sizes. The r-f oscillator frequency is made to agree with the scale markings by means of the trimmer capacitor (C_{12}) mounted on the side of the main tuning capacitor (C_{11}), which is located as shown in Fig. 21-20. The process of adjusting the oscillator to the proper frequency is known as *calibration*. Since the stray capacitances are also affected when the signal generator is mounted in its metal case, an access hole is provided in the side of the case through which you can

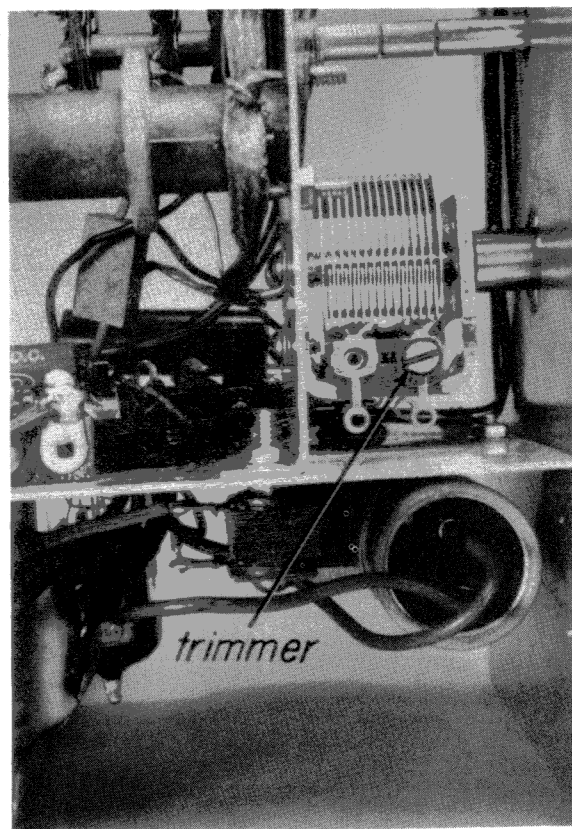


Fig. 21-20

touch up the calibration, if necessary, after the signal generator is placed in its case.

Your best source of a signal of known frequency to use for calibration is a local broadcast station picked up on a radio receiver. Broadcast stations are required by the Federal Communications Commission (FCC) to operate on an assigned frequency and maintain this frequency within plus or minus 20 cycles. This means that a station operating on its assigned frequency must maintain its stability by keeping the transmitter oscillator in a temperature controlled oven and checking its frequency every half hour. When we calibrate a signal generator against a broadcast station of known frequency, we are taking advantage of the accuracy of the broadcast station signal. The assigned frequency of local stations is usually given in the radio section of your newspaper.

If you do not have a radio receiver available at this time, you can calibrate your signal generator after you complete construction of your radio receiver in Experiment Lesson 32. Your signal generator can still be used as an audio source since the audio oscillator is not affected by the r-f calibration.

Procedure.

Step 1. Turn the signal generator on and let it warm up about 15 minutes. While the signal generator is warming up, you can prepare the equipment for calibration.

Step 2. Set the bandswitch to Band B, turn the AF OUT/INT MOD control off and set the RF ATTEN control to maximum.

Step 3. Gently turn the trimmer on the signal generator capacitor clockwise until it is tight. (Do not apply too much pressure or you will strip the threads.) Then turn the trimmer screw about one-quarter turn *counterclockwise*.

Step 4. Connect the output cable to the RF OUTPUT connector, and connect the alligator clip from the center conductor of the output cable to a piece of hookup wire about a foot or two long. Let the other alli-

gator clip hang free. The signal generator is now ready for calibration.

Step 5. Tune your radio receiver to a broadcast station of known frequency between about 1,000 and 1400 kc. Lay the hookup wire from the signal generator behind the radio, or near its antenna terminal or loop. No connection is necessary between the signal generator and the radio.

Step 6. Tune the signal generator with the main tuning dial until you hear a whistle in the radio loudspeaker. The signal-generator frequency as read on the front panel should be fairly close to the station frequency. Move the wire away from the receiver till the whistle is no louder than the sound from the station to which the receiver is tuned.

Step 7. Set the front-panel dial pointer of the signal generator to the exact frequency of the station that you are using for calibration. Do not move the main tuning dial of the signal generator until the calibration is completed. Turn the trimmer on the signal-generator tuning capacitor very slowly till you hear the whistle again in the receiver loudspeaker. The frequency of this whistle is the difference frequency between the signal generator and the station frequency to which the receiver is tuned. As the signal generator frequency comes closer to the station frequency, the tone will become lower in frequency, decreasing to almost zero when the signal generator and radio are exactly on the same frequency. If you continue to adjust the trimmer in the same direction, the frequency of the whistle will get higher. When the signal generator and radio receiver are tuned to exactly the same frequency, they are said to *zero beat*. That is, there is no difference in frequency between them, so the tone you hear is zero or no whistle. Tuning to either side of this point with the trimmer should produce a whistle or *beat note*. The audio frequency of this beat note is the difference between the signal generator and the broadcast station frequencies. The proper setting of the trimmer is the point of lowest frequency between the

two high pitched whistles. Turn the trimmer very slowly until you locate this point. When your signal generator zero beats with the broadcast station, and the dial pointer shows this same frequency on the front panel, your signal generator is calibrated.

JOB 21-12

To mount the signal generator in its case.

Procedure.

Step 1. Attach the four rubber feet to the bottom of the signal generator case, using self-tapping screws through the holes in the bottom of the case.

Step 2. Mount the signal generator in the case, making sure that the trimmer capacitor

is lined up with its access hole. Attach the front panel to the case with four self-tapping screws. Be very careful not to scratch the front panel when you tighten the screws.

Step 3. Slide the rubber grommet on the line cord into the slot on the rear panel, and insert the two self-tapping screws that hold the rear panel to the signal generator sub-chassis. Then fasten the rear panel in place on the case with four self-tapping screws.

JOB 21-13

To check and touch up the signal generator calibration.

Information. Mounting the signal generator in its case will usually affect the calibration slightly. This is because the metal case changes the distributed capacitance between the wiring and the case or ground. The signal

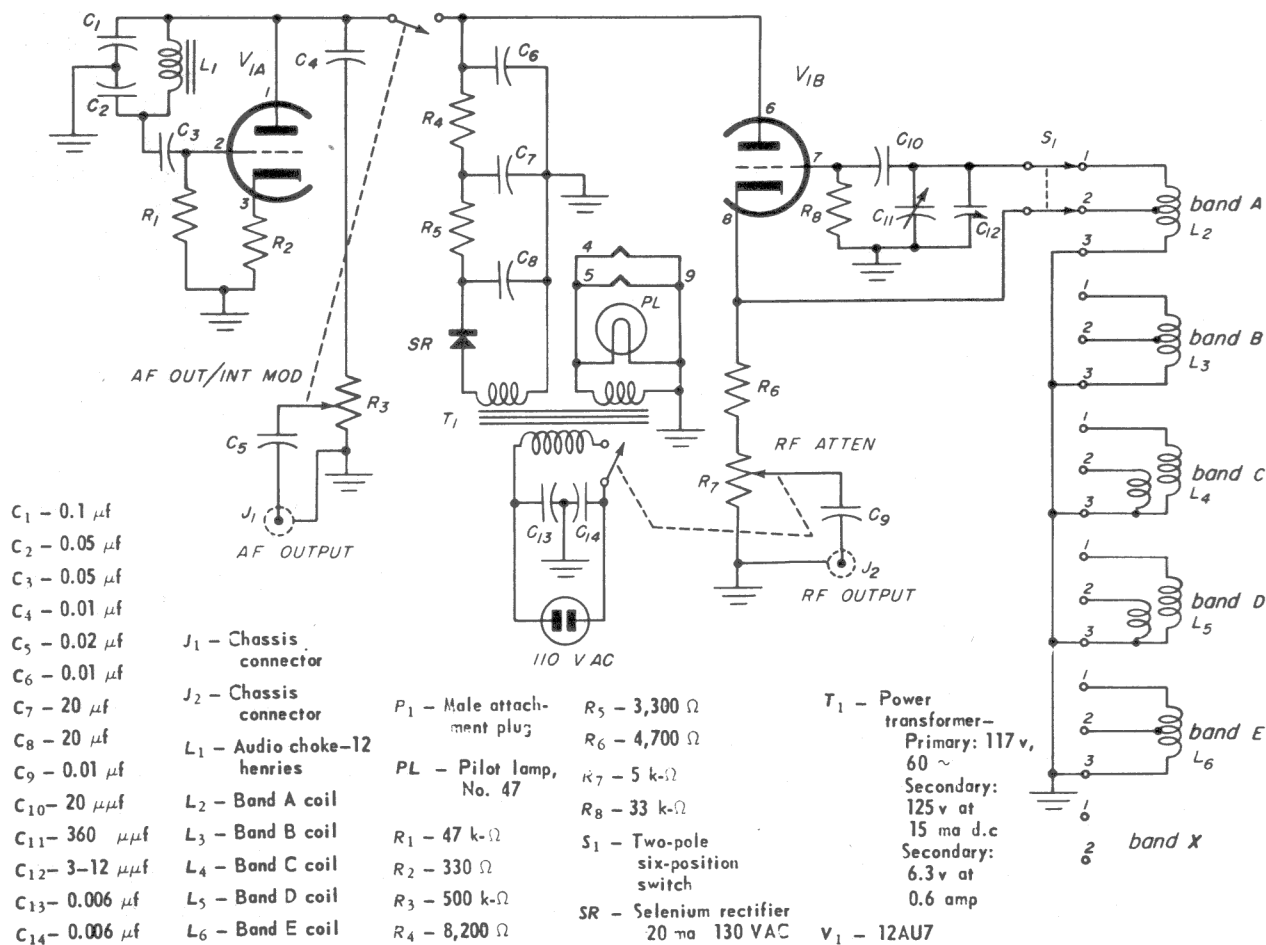


Fig. 21-21

generator is recalibrated by readjusting the trimmer through the access hole in the case.

Procedure.

Step 1. Set up the signal generator and a radio receiver in the same manner as you did for the original calibration in Job 21-11.

Step 2. Check that the signal-generator dial is exactly set to the frequency of the station to which the radio receiver is tuned. Place a screwdriver through the access hole on the right side of the signal generator case and adjust the trimmer to obtain zero beat. Do this very slowly and carefully because the amount of adjustment necessary is very small.

Step 3. Now check the operation of the signal generator by tuning it to half the frequency of the broadcast station. Do not touch the tuning capacitor of the radio receiver. You should again get a zero beat as the signal generator is tuned to approximately half the frequency of the station. The *second harmonic* of the signal generator is now beating with the station.

All signal generators have some harmonic output on multiples of the frequency to which they are tuned. For example, if the receiver is tuned to a station at 1440 kc, and you zero beat with your signal generator near 720 kc, the second harmonic of the signal generator is beating with the station. Do not adjust the trimmer when testing with harmonics. If you do not get a zero beat when the signal generator is tuned to one-half the frequency at which the trimmer adjustment was made, then this adjustment was incorrectly made. Move the signal generator further away from the receiver, shorten the antenna wire, and repeat Job 21-11. If a zero-beat occurs at more than one position of the trimmer, use the position giving strongest beat note.

Step 4. After you have checked your signal generator, insert the 3/8-inch snap-in plug into the access hole. Your signal generator is now completed. The schematic of your signal generator (Fig. 21-21) will be helpful in future troubleshooting.



$$\begin{array}{r} 25.2 \\ \times .15 \\ \hline 1260 \\ 2520 \\ \hline 3.780 \end{array}$$

12BAT - 12.6 V
12SK7 - 12.6 V
12SQ7 - 12.6 V
25Z6 - 25 V
50L6GT - 50 V
87.8
112.8

$$\begin{array}{r} 79.2 \\ \times .45 \\ \hline 3960 \\ 3168 \\ \hline 35.640 \end{array}$$

35.6 watts

$$R = \frac{E}{I} = \frac{87.8}{.15} = 585 \Omega$$

$$P = I^2 R = .15^2 \cdot 585$$

$$\begin{array}{r} 585 \Omega \\ \times .15 \\ \hline 75 \\ 128 \\ \hline 80 \end{array}$$

$$\begin{array}{r} .15 \\ \times .15 \\ \hline .0225 \\ 15 \\ \hline 1025 \\ 585 \\ \hline 1125 \\ 1800 \\ \hline 151625 \end{array}$$

$$\begin{array}{r} .15 \\ \times .15 \\ \hline .0225 \\ 15 \\ \hline 1025 \\ 585 \\ \hline 1125 \\ 1800 \\ \hline 151625 \end{array}$$

$$\begin{array}{r} 112.8 \\ \times 4.2 \\ \hline 4536 \\ 11280 \\ \hline 4737.6 \end{array}$$

$$\begin{array}{r} 81.6 \\ \times .055 \\ \hline 4488 \\ 44880 \\ \hline 4497.6 \end{array}$$

$$\begin{array}{r} 5.6 \\ \times .012 \\ \hline 112 \end{array}$$

$$P = EI$$

$$RP = I \cdot R$$

$$100(E_1 - E_2) = \frac{100(313.5 - 300)}{300}$$

1 - without
2 - with load

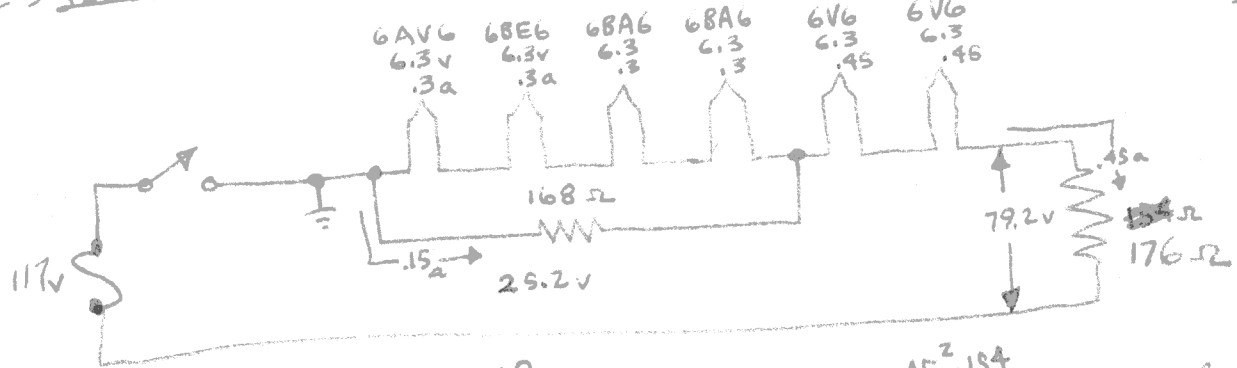
$$\begin{array}{r} 6.3 \\ \times 4 \\ \hline 25.2 \end{array}$$

$$\begin{array}{r} 6.3 \\ \times 6 \\ \hline 37.8 \end{array}$$

$$\begin{array}{r} 117 \\ \times 37.8 \\ \hline 79.2 \end{array}$$

$$R = \frac{E}{I} = \frac{79.2}{.45} = 176 \Omega$$

$$\begin{array}{r} .45 \\ \times .45 \\ \hline .2025 \\ 180 \\ \hline 2025 \\ 154 \\ \hline 8000 \\ 10125 \\ \hline 2025 \\ 31.1850 \end{array}$$



$$\begin{array}{r} .2025 \\ \times 176 \\ \hline 12150 \\ 14175 \\ \hline 2025 \\ 356400 \end{array}$$

$$\begin{array}{r} 168 \\ \times 15 \\ \hline 2520 \\ 106 \\ 90 \\ \hline 120 \\ 120 \end{array}$$

$$P = I^2 R = .45^2 \cdot 154$$

$$P = 31 \text{ watts}$$

$$\begin{array}{r} 79.2 \\ \times 6.3 \\ \hline 5001.6 \\ 25.2 \\ \hline 117.0 \end{array}$$